still in the Cainozoic or Cretaceous age would hardly be consistent with the necessary terminology of geological science.

During the end of the Miocene age and the whole of the Pliocene the Sicilian area was occupied by a deep sea. The distinction between the faunas of those times and the present becomes less, year after year, as science progresses ; and it is evident that a great number of existing species of nearly every class flourished before the occurrence of the great changes in physical geology which have become the artificial breaks of tertiary geologists. That the Cainozoic deep-sea corals should resemble, and in some instances should be identical in species with, the forms now inhabiting vast depths, is therefore quite in accordance with the philosophy of modern geology. Before the deposition of the Cainozoic strata, and whilst the deep-sea deposits of the Eocene age were collecting in the Franco-British area, there was a Madreporarian fauna there which was singularly like unto that which followed it, both as regards the shape of the forms and their genera. Still earlier, during the slow subsidence of the great Upper Cretaceous deep-sea area, there was a coral-fauna in the north and west of Europe, of which the existing is very representative. The simple forms predominate in both faunas. *Caryophyllia* is a dominant genus in either ; and a branching *Synhelia* of the old fauna is replaced in the present state of things by a branching *Lophohelia*. The similarity of deep-sea coral-faunas might be carried still further back in the world's history ; but it must be enough for my purpose to assert the representative character and the homotaxis of the Upper Cretaceous, the Tertiary, and the existing deep-sea coral-faunas. This character is enhanced by the persistence of types ; but still the representative faunas are separable by vast intervals of time.

March 31, 1870.

Lieut.-General Sir EDWARD SABINE, K.C.B., President, in the Chair.

The following communications were read :—

I. "On the Relation between the Sun's Altitude and the Chemical Intensity of Total Daylight in a Cloudless Sky." By HENRY E. ROSCOE, F.R.S., and T. E. THORPE, Ph.D. Received March 3, 1870.

(Abstract.)

In this communication the authors give the results of a series of determinations of the chemical intensity of total daylight made in the autumn of 1867 on the flat tableland on the southern side of the Tagus, about $8\frac{1}{2}$ miles to the south-east of Lisbon, under a cloudless sky, with the object of ascertaining the relation existing between the solar altitude and the

chemical intensity. The method of measurement adopted was that described in a previous communication to the Society*, founded upon the exact estimation of the tint which standard sensitive paper assumes when exposed for a given time to the action of daylight. The experiments were made as follows:—

1. The chemical action of total daylight was observed in the ordinary manner.

2. The chemical action of the diffused daylight was then observed by throwing on to the exposed paper the shadow of a small blackened brass ball, placed at such a distance that its apparent diameter, seen from the position of the paper, was slightly larger than that of the sun's disk.

3. Observation No. 1 was repeated.

4. Observation No. 2 was repeated.

The means of observations 1 and 3 and of 2 and 4 were then taken. The sun's altitude was determined by a sextant and artificial horizon, immediately before and immediately after the observations of chemical intensity, the altitude at the time of observation being ascertained by interpolation.

It was first shown that an accidental variation in the position of the brass ball within limits of distance from the paper, varying from 140 millims. to 230 millims., was without any appreciable effect on the results. One of the 134 sets of observations was made as nearly as possible every hour, and they thus naturally fall into seven groups, viz.:—

(1) Six hours from noon, (2) five hours from noon, (3) four hours from noon, (4) three hours from noon, (5) two hours from noon, (6) one hour from noon, (7) noon.

Each of the first six of these groups contains two separate sets of observations,—(1) those made before noon, (2) those made after noon. It has already been pointed out†, from experiments made at Kew, that the mean chemical intensity of total daylight for hours equidistant from noon is the same. The results of the present series of experiments prove that this conclusion holds good generally; and a Table is given showing the close approximation of the numbers obtained at hours equidistant from noon.

Curves are given showing the daily march of chemical intensity at Lisbon in August, compared with that at Kew for the preceding August, and at Pará for the preceding April. The value of the mean chemical intensity at Kew is represented by the number 94·5, that at Lisbon by 110, and that at Pará by 313·3, light of the intensity 1 acting for 24 hours being taken as 1000.

The following Table gives the results of the observations arranged according to the sun's altitude.

* Roscoe, Bakerian Lecture, 1865.

† Phil. Trans. 1867, p. 558.

No. of observations.	Mean altitude.	Chemical Intensity. Sun.	Sky.	Total.
15	9° 51′	0·000	0·038	0·038
18	19 41	0·023	0·063	0·085
22	31 14	0·052	0·100	0·152
22	42 13	0·100	0·115	0·215
19	53 09	0·136	0·126	0·262
24	61 08	0·195	0·132	0·327
11	64 14	0·221	0·138	0·359

Curves are given showing the relation between the direct sunlight (column 3) and diffuse daylight (column 4) in terms of the altitude. The curve of direct sunlight cuts the base line at 10°, showing that the conclusion formerly arrived at by one of the authors is correct, and that at altitudes below 10° the direct sunlight is robbed of almost all its chemically active rays. The relation between the total chemical intensity and the solar altitude is shown to be represented graphically by a straight line for altitudes above 10°, the position of the experimentally determined points lying closely on to the straight line.

A similar relation has already* been shown to exist (by a far less complete series of experiments than the present) for Kew, Heidelberg, and Pará; so that although the chemical intensity for the same altitude at different places and at different times of the year varies according to the varying transparency of the atmosphere, yet the relation at the same place between altitude and intensity is always represented by a straight line. This variation in the direction of the straight line is due to the opalescence of the atmosphere; and the authors show that, for equal altitudes, the higher intensity is always found where the mean temperature of the air is greater, as in summer, when observations at the same place at different seasons are compared, or as the equator is approached, when the actions at different places are examined. The differences in the observed actions for equal altitudes, which may amount to more than 100 per cent. at different places, and to nearly as much at the same place at different times of the year, serve as exact measurements of the transparency of the atmosphere.

The authors conclude by calling attention to the close agreement between the curve of daily intensity obtained by the above-mentioned method at Lisbon, and that calculated for Naples by a totally different method.

* Phil. Trans. 1867, p. 555.